

## Short Communication

### VERTICILLIUM WILT RESISTANT GERMPLASM: RELEASE OF RUSSET CLONE B0169-56

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#### Abstract

Potato breeding selection B0169-56 is being released by the United States Department of Agriculture, Agricultural Research Service as germplasm that is highly resistant to *Verticillium albo-atrum* Reinke & Berthier and *V. dahliae* Kleb. In five years of field testing in the Verticillium wilt plot in Presque Isle, Maine, the level of resistance as measured by symptom severity is equal to that of Russette. In 1993, in plots inoculated with both species of *Verticillium*, there was a 15, 27 and 62% yield reduction for B0169-56, Russette, and Superior, respectively. After four years of evaluation in yield and processing trials in Presque Isle, Maine, B0169-56 has yielded and fried as well as Russet Burbank. Tubers are russet-skinned, oblong to long and cylindrical. Tubers of B0169-56 size early, a necessary quality for an eastern russet. It is both female and male fertile. This selection is currently undergoing further evaluation at multiple state locations for possible commercialization. Seed is available from the USDA/ARS, Beltsville, Maryland.

#### Introduction

Verticillium wilt, a fungal disease in potatoes caused by *Verticillium albo-atrum* Reinke & Berthier or *V. dahliae* Kleb. alone (8) or in combination with root lesion nematodes (13, 14, 15) or soft rot bacteria (12), is an important factor in the economically important potato early dying disease. This disease has been reported to cause yield reductions of up to 50 percent (10).

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Soil fumigation, crop rotation, and resistant varieties can be used to control *Verticillium* wilt. Environmental concerns and expenses associated with soil fumigation limit its usefulness (11). Crop rotations of 5-10 years are necessary to reduce inoculum in moderately infected fields (3). Disease resistant varieties offer the most practical method for controlling *Verticillium* wilt (15).

Resistance to *Verticillium* wilt in potatoes is heritable (7, 16). The USDA/ARS potato breeding program in Aberdeen, Idaho and the University of Idaho have been jointly breeding for *Verticillium* wilt resistance since the 1950's (9). Recently, two *Verticillium* wilt resistant clones were released by the USDA/ARS and the University of Idaho (2).

The USDA/ARS potato breeding program in Beltsville, Maryland has also been breeding for *Verticillium* wilt resistance (1). The cvs. Abnaki and Russette which have *Verticillium* wilt resistance were released by this program. For the past five years one particular selection, B0169-56, has had excellent field resistance to *Verticillium* wilt (4). It also has the horticultural and processing characteristics required for a successful commercial variety. This report describes the pedigree, *Verticillium* wilt resistance, yield, processing, plant and tuber characteristics of B0169-56.

### Materials and Methods

*Verticillium* isolates used for evaluating this clone were recovered from potato plants with symptoms of *Verticillium* wilt. Inoculum was prepared by growing the isolates in 100 x 15 mm plastic petri dishes containing 25 ml of 17.5 g Difco Czapek-Dox broth, 19.5 g Difco potato dextrose agar, and 10 g Difco agar per liter of distilled water. After 21 days incubation at 20-22 C, the cultures were comminuted in a blender, and the resultant slurry was diluted with distilled water to contain  $10^9$  conidia/ml.

Each seed tuber was cut into seed pieces weighing 40-60 g, and seed pieces were immersed in the inoculum or in Difco Czapek-Dox broth for 1 min immediately prior to planting. Seed pieces were hand planted in rows spaced 0.76 m apart at 0.3 m intra-row spacing at Aroostook State Farm in Presque Isle, Maine. Seed pieces were covered with soil immediately after planting.

From 1988 to 1992 B0169-56 was one of 18 clones evaluated for their reaction to infection by *Verticillium albo-atrum* and *V. dahliae* in replicated field plots. In 1988 and 1989, when each clone was evaluated for its reaction to infection by *Verticillium albo-atrum* and *V. dahliae* alone or in combination, the clones were arranged in a randomized complete block design. During 1990, 1991, and 1992, all plots were inoculated with the combination of *V. albo-atrum* and *V. dahliae* in a randomized complete block design. The Horsfall-Barratt scheme (7) was used to evaluate the severity (1=0% disease . . . 12=100%) of *Verticillium* wilt. Individual plants in each plot were

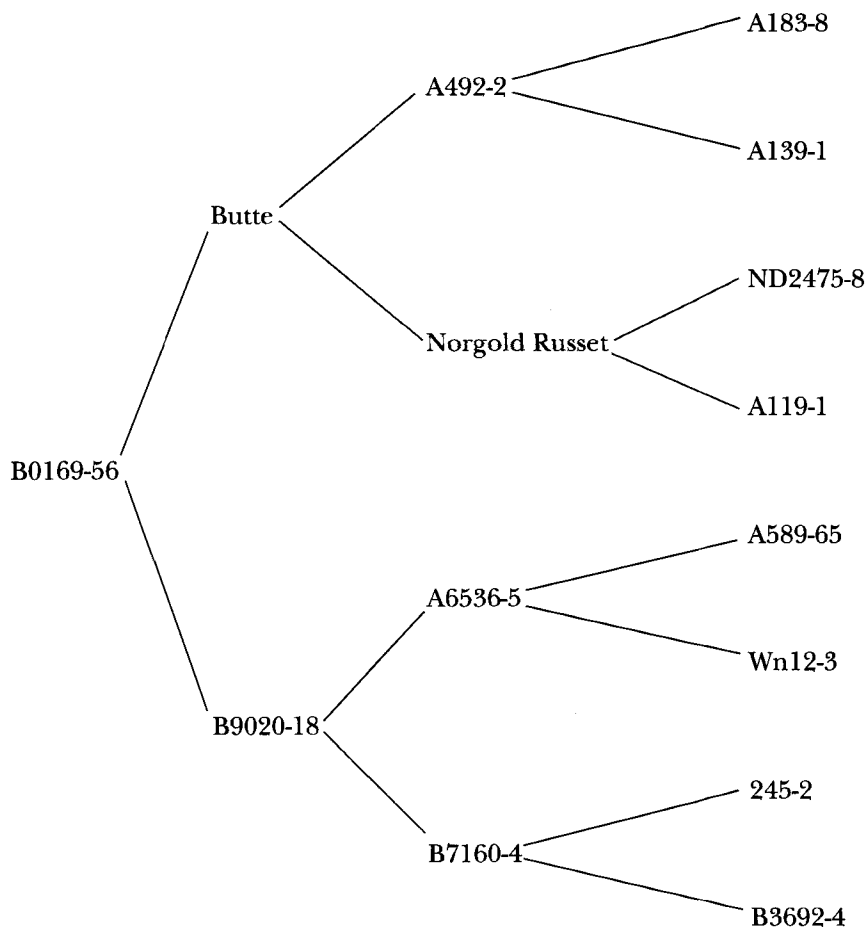


FIG. 1. Pedigree of B0169-56.

rated for disease approximately 90 days after planting, and mean disease severity of *Verticillium* wilt was calculated for each plot.

In 1993, the experimental design in the *Verticillium* plot yield trial was a split-plot with three replications. Genotypes were the whole plot factor. Sub-plots were either non-inoculated or inoculated with both species of *Verticillium*. Sub-plots consisted of five rows of 10 hills for each genotype. Plots from the middle three rows were harvested and total weight recorded.

#### Pedigree of B0169-56

The pedigree of B0169-56 is presented in Figure 1. The female parent, Butte, is a full-sib to A66107-51 which was jointly released by the United

TABLE 1.—*Severity of Verticillium wilt\* for clones inoculated with Verticillium albo-atrum (Vaa), V. dahliae (Vd), and the combination of the two, from 1988 to 1992.*

	Vaa	Vd	Vaa+Vd
	1988		
B0169-56	1.0	1.0	1.0
Abnaki	1.0	1.0	1.0
Reddale	1.2	1.0	1.0
Russette	1.0	1.0	1.0
Superior	7.2	3.9	5.5
	1989		
B0169-56	2.1	2.2	2.2
Abnaki	2.2	1.5	1.7
Reddale	1.1	1.3	2.1
Russette	5.3	3.4	3.7
Superior	8.5	8.0	7.9
	1990		
B0169-56	NT	NT	1.1
Abnaki	NT	NT	1.2
Reddale	NT	NT	1.0
Russette	NT	NT	1.2
Superior	NT	NT	4.6
	1991		
B0169-56	NT	NT	2.3
Abnaki	NT	NT	1.3
Reddale	NT	NT	1.8
Russette	NT	NT	2.0
Superior	NT	NT	7.3
	1992		
B0169-56	NT	NT	1.0
Abnaki	NT	NT	1.8
Reddale	NT	NT	1.8
Russette	NT	NT	1.0
Superior	NT	NT	7.7

\*Severity of Verticillium wilt using the Horsfall-Barratt rating system (1=0% wilt . . . 12=100% wilt).

NT = Not tested.

States Department of Agriculture, Agricultural Research Service and the University of Idaho for its Verticillium wilt resistance (2). The male parent, B9020-18, has as its maternal parent A6536-5. A6536-5 is a half-sib to A681134 which was also jointly released by the USDA/ARS and the University of Idaho for its Verticillium wilt resistance. General adaptation to the eastern United States was incorporated from B9020-18. B0169-56 was first grown in 1983.

TABLE 2.—Yields (kg) in 30 hill plots inoculated with both species of *Verticillium* or non-inoculated, and percent reduction in yield due to *Verticillium* inoculation in Presque Isle, Maine in 1993.

Clone	Yield in Inoculated Plots	Yield in Non-inoculated Plots	Percent Reduction
B0169-56	24.9	29.2	15
Russette	24.2	33.2	27
Superior	13.7	35.8	62

### Characteristics of B0169-56

#### *Verticillium* Wilt Resistance

The *Verticillium* wilt reaction of B0169-56 was first evaluated in replicated field trials in 1988. The performance of this selection from 1988-1992 has been well documented (4, 6) (Table 1). B0169-56 is resistant to both *Verticillium dahliae* and *V. albo-atrum* (4). Of 16 clones which were tested from 1990 to 1992, the *Verticillium* wilt resistance of B0169-56 was equal to that of Abnaki, Reddale, and Russette.

In 1993, B0169-56, Superior and Russette were evaluated for their yield potential under *Verticillium* wilt stress. There was a 15, 27 and 62% yield reduction for B0169-56, Russette and Superior, respectively, in the inoculated plots (Table 2).

#### *Other Disease and Insect Resistances*

B0169-56 is resistant to race A of the golden nematode (*Globodera rostochiensis*). Its scab resistance is similar to that of Superior and better than that of Russet Burbank (5).

### Yield and Processing Characteristics

B0169-56 has been tested in replicated yield trials at the Echo Lake site in Presque Isle, Maine since 1989 (Table 3). Trials were planted in a randomized complete block design with four replications of 25 hills spaced 30.5 cm within the row. It has yielded as well as Russet Burbank with fewer tubers under 2 ounces. The specific gravity of B0169-56 was similar to that of Russet Burbank except in 1991 when it was appreciably higher. The 1991 growing season was extremely hot and dry with little rainfall until the end of August. The lower specific gravity of Russet Burbank in 1991 may have been due to its late maturity versus the medium maturity of B0169-56. The

TABLE 3.—*Yield, quality and processing characteristics of B0169-56 compared to Russet Burbank from 1989-1992 in Presque Isle, Maine.*

Clone	Mkt	%	% Size Distribution					SG <sup>b</sup>	HH <sup>c</sup>	Fry <sup>d</sup>
	cwt/A	Mkt	<2	2-6	6-10	10-16	>16 <sup>a</sup>			
1989										
B0169-56	356	86	11.6	34.2	42.4	9.0	2.8	77	0	3.9
Russet										
Burbank	383	82	12.6	31.6	37.4	13.3	5.1	81	1	3.5
1990										
B0169-56	316	88	12.1	35.4	38.9	13.5	0.0	74	0	3.8
Russet										
Burbank	266	74	25.9	47.9	15.2	11.0	0.0	69	0	4.1
1991										
B0169-56	227	86	13.7	50.2	34.0	2.0	0.0	90	0	3.3
Russet										
Burbank	205	81	18.6	45.3	28.9	7.3	0.0	75	0	4.1
1992										
B0169-56	354	71	7.5	21.8	23.0	26.1	21.5	82	4	4.5
Russet										
Burbank	384	81	9.7	40.0	22.4	18.8	9.1	83	20	4.2

<sup>a</sup>Sizes given are in ounces.<sup>b</sup>1.0 omitted.<sup>c</sup>Number of tubers with hollow heart out of the largest 20 cut. In 1991, only 13 tubers of B0169-56 and 17 tubers of Russet Burbank were cut.<sup>d</sup>Fried out of 50 F in January. 1-3=satisfactory, >3=unsatisfactory.

combined precipitation for the months of June and July was 20.0 cm for 1992 and 5.6 cm for 1991. This 14.4 cm increase may account for the increased incidence of hollow heart in Russet Burbank and the decrease in percent marketable tubers in 1992 for B0169-56 (Table 3). The ability of B0169-56 to produce french fries out of 50 F storage in Maine is similar to that of Russet Burbank.

### Description

**PLANTS:** medium to medium late in maturity. The vine is small to medium with generally adequate row cover. Vines are upright at blossom stage. Stems are medium green with slight pubescence, very little or no pigmentation, and inconspicuous nodes. **Wings:** small, slightly waved, double. **Stipules:** medium size, spreading. **Leaves:** medium green, smooth with little

pubescence, open type. *Terminal leaflets*: medium size, most are symmetrical and lobate. *Primary leaflets*: medium large, lobate and asymmetrical, usually three pairs. *Secondary leaflets*: numerous. *Tertiary leaflets*: small and abundant. *Midribs*: medium green with slight pubescence. *Petioles*: medium green, very little pubescence.

*FLOWERS*: very abundant in the field, much less so in the greenhouse. Inflorescence borne on long peduncle raised well above foliage. *Peduncle*: long, medium green, pubescent. *Buds*: light purple with creamy white tips. *Calyx*: 11 mm when corolla is fully open, slender, triangular shape, medium to dark green, pubescent. *Corolla*: 39 mm diameter, light purple, with cream tips. Fading occurs by full expansion at which time the corolla is flat. *Anthers*: yellow-orange. *Pollen*: abundant. *Fertility*: both male and female fertile.

*TUBERS*: oblong, long, cylindrical, mean length  $94.0 \pm 9.4$  mm, mean depth  $55.4 \pm 4.6$  mm, mean width  $65.4 \pm 6.3$  mm. *Indices*: width to length, 69.6; depth to length, 58.9; width to depth, 118.1. *Skin*: russeted. *Eyes*: shallow. *Flesh*: creamy-white. *Dormancy*: short. Total glycoalkaloid content in 1992 was 5.8 mg/100 grams fresh weight, which is well within accepted limits.

#### *Availability*

Limited seed of B0169-56 is available for research purposes from K.G. Haynes, USDA/ARS.

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